Renewable and Sustainable Energy Reviews 16 (2012) 3574–3578

Contents lists available at SciVerse ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Regulatory transparency—How China can learn from Japan's nuclear regulatory failures?☆

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ARTICLE INFO

Article history:
Received 1 February 2012
Received in revised form 25 February 2012
Accepted 2 March 2012
Available online 28 April 2012

Keywords:
Japan's nuclear regulatory failures
Regulatory transparency
Public involvement
China's nuclear energy policymaking
Policy recommendation

ABSTRACT

Investigations before and after the Fukushima nuclear accident revealed nuclear accidents like Fukushima would have unlikely happened in a country with transparency and public participation regarding nuclear issues. However, this lack of transparency and public involvement is unique not only to Japan. China is rushing to build reactors, hosting over 40% of the reactors under construction worldwide, but transparency and public involvement is overlooked and even discouraged. China's nuclear policymaking has relied heavily on closed panels of expert opinions, exclusive of public oversight or awareness. In China, public involvement of nuclear policies has not been welcomed. The lack of public participation has streamlined and simplified building procedures for nuclear reactors, which facilitated building too many reactors too fast. There are currently 27 reactors under construction in China that vary in the use of generations II, III, and IV reactors. No other country in history has experienced nuclear energy expansion with so many different types of reactors under simultaneous construction in such a short time. To prevent the next Fukushima, more efforts are required not to repeat the same mistake made by Japan; China should encourage public participation and awareness regarding nuclear issues by giving high priority to a transparent approach.

Contents

1. Introduction

On 11 March 2011, a magnitude 9.0 earthquake and 14-m tsunami triggered a series of equipment failures, nuclear meltdowns, and radioactive material released at the Fukushima Daiichi Nuclear Power Plant in Japan [1,2]. In light of the worst nuclear accident since the Chernobyl, the Chinese government announced on 16 March 2011 to suspend approval for nuclear power plants across the country, putting the brakes on a development program that constitutes over 40% of the reactors under construction worldwide [3]. This decision, uncharacteristic of the Chinese government usually racing ahead with ambitious infrastructure projects, was right and timely [4]. However, so far, January 2012, the open question has remained how the Chinese government is going to improve nuclear energy safety.

In the authors' view, effective actions to strengthen China's nuclear safety regulation should be derived upon a thorough assessment of Japan's nuclear regulation, as well as a comparative analysis of the nuclear regulation in Japan and China which are rushing to embrace atomic energy to meet the growing power demand, with inadequate experience of nuclear safety regulations. To this end, this article is intended to conduct an analysis the relationship between non-transparency and Japan's nuclear safety regulatory

☆ The views expressed in this article are the authors' and do not necessarily reflect reviews of Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences.

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doi:10.1016/j.rser.2012.03.001

failure, assess civilian nuclear energy regulatory transparency in China, and finally two key policy recommendations are proposed.

2. Non-transparency blame for Japan's nuclear regulatory failure

Both Official agency (e.g., International Atomic Energy Agency (IAEA) [1], Japan's Nuclear and Industrial Safety Agency (NISA) [2], The Investigation Committee on the Accidents at the Fukushima Nuclear Power Stations of Tokyo Electric Power Company [5], U.S. Nuclear Regulatory Commission (NRC) [6], Japan Atomic Energy Commission (AEC) [7], and The Tokyo Electric Power Company (TECPO) [8]), and academic researchers (such as Bunn and Heinonen [9], Kaufman [10], Perrow [11], Wang et al. [12–14], and Nöggerath et al. [15]) have pointed out that the failures of the Japan's nuclear safety regulation also were be blamed to the Fukushima nuclear accident. There is also widespread criticism that the Japanese nuclear agency's lack of independence mainly contributed to the regulatory failure [1,2,7,9,10,12,13]. NISA is the nuclear safety regulator, but it is a division of Ministry of Economy, Trade and Industry (METI). METI is also reposbile for promoting the nuclear sector. Thus, NISA has multiple and seemingly conflicting roles. NISA is a promoter of nuclear industry, but at the same time regulates nuclear safety. Here we contended that non-transparency and inadequate public oversight also has contributed to the Japan's nuclear regulatory failures.

In the nuclear accident at Fukushima Daiichi nuclear power plant, the Japanese government and the TEPCO received numerous complaints about their uninformative public release [16–18]. On 29 July 2011, Yukiya Amano, Director General of IAEA openly criticized TEPCO because that "*sufficient information failed to reach the IAEA in the initial phase of the accident*"[19]. On 4 July 2011, the Atomic Energy Society of Japan, a group of nuclear scholars and industry executives, admitted, ". . .this sort of important information (radiation monitoring) was not released to the public until three months after the fact." [18]. This is indicative of a lack of transparency and public participation in over three decades of Japanese nuclear policies [20–24].

Investigations before and after the Fukushima nuclear accident revealed that Japan's nuclear regulatory system had been compromised by a closed community known as the "nuclear power village" [10,20–23,25,26]. This "village" had been established since the 1970s oil crisis under the banner of "energy security" (i.e., promoting atomic energy to reduce Japan's heavily reliance on imported fuel) [20,25]. However, asymmetric information had obstructed public scrutiny over this interest group before the Fukushima accident [10,20,22]. Indeed, *Amakudari* and *Amaagari*, an illegal revolving door between nuclear regulator and operator, has become a widespread practice. *Amukudari* allows Japanese nuclear bureaucrats retired into cushy jobs at the nuclear utilities they once regulated [10,12,21,22]. From 1959 to 2010, at TEPCO alone, four former top-ranking nuclear regulation officials successively served as vice presidents at the company [21]. Amaagari allows the Japan nuclear agencies freely hire from nuclear industry [12,21]. Pritchard et al. [26], examined 95 people currently employed with Japan's regulatory bodies – 26 of whom are affiliated with the nuclear industry.

It should also be pointed out that the movement of *amakudari* and *amaagari* has also become a practice without public oversight. For example, Mr. Tokio Kano joined TEPCO in 1957, became a leader in the utility's nuclear unit in 1989, and in 1998 entered Japan's parliament as a candidate for a seat given to the nation's largest business lobbying group. In parliament, Mr. Kano led a campaign to reshape the country's energy policy by putting nuclear power at its center. In 2003, on the strength of Mr. Kano's leadership, Japan adopted a national basic energy plan calling for the growth of nuclear energy as a way to achieve greater energy independence and to reduce Japan's emission of greenhouse gases. The plan and subsequent versions mentioned only in broad terms the importance of safety at the nation's nuclear plants despite the 2002 disclosure of cover-ups at Fukushima Daiichi and a 1999 accident at a plant northeast of Tokyo in which high levels of radiation were spewed into the air. After two six-year terms, Mr. Kano returned to TEPCO as an adviser in July 2010 [12,21,27,28].

Naturally, the incestuous relationship between nuclear regulators and operators lead Japan's nuclear agency become caretakers of nuclear industry, rather than safety watchdogs [10,12,13]. Japan's regulatory documents have listed that the Fukushima Daiichi nuclear plant was rated one of the five worst nuclear plants in the world between 2004 and 2008 [29] and one of the most trouble-prone nuclear facilities in Japan in the last decade [30,31]. However, without transparency and public scrutiny [20–22], NISA approved the Fukushima Daiichi nuclear plant operation, and even granted to extend its unit 1 reactor an additional 10 years on 7 February 2011, after the reactor ended its designed lifecycle [32].

3. Implication for China's nuclear energy

Available information therefore indicates that a lack of transparency and public participation has contributed to Japan's nuclear regulatory failures. And the worst nuclear accident since Chernobyl could have been averted if proper transparency and public scrutiny was encouraged rather than discouraged. Unfortunately, a lack of transparency and public participation is not unique to Japan. Mirroring Japan's mistakes, propelled by skyrocketing energy demands, these emerging countries are rushing to build reactors, often overlooking the necessity of transparency and public involvement. Most of the world's 63 reactors currently under construction are in emerging countries [3,33]. It is a problem also evident in China, which is currently building 26 reactors (until January 2012) – over 40% of the total under construction worldwide.

China's current nuclear policies have relied heavily on closed expert panels, rather than public involvement [34–36]. How it operates can be demonstrated by the approval process of a reactor. After a nuclear operator submits its new reactor application to the National Development and Reform Commission (NDRC), a panel of expert evaluates the application. The NDRC relies on the panel's findings when delivering its proposal to the State Council, which makes the final decisions [34,36]. However, the majority of the experts involved are believed to be affiliated with nuclear operators, because most of nuclear institutes are subsidiaries of nuclear utilities in China [36].

The question remains: How will China avoid the potential conflict of interest evident in Japan's nuclear policymaking. In a safety guideline submitted in December 2001, TEPCO told NISA that sea waves that impacted the Fukushima Daiichi plant would not exceed 5.7 m [8,37]. Unfortunately, on March 11, the tsunami waves impacting the plant were 14 m high, shutting down the electricity of cooling system of the reactors, and triggering the worst nuclear accident since Chernobyl [38]. It is believed that 22 of the 35 experts on the committee that submitted the safety guideline had strong ties to the nuclear industry [26].

Mirroring Japan's mistakes, China's public participation has not been welcomed in nuclear assessments and safety oversight [34,35], despite requirements for environmental impact assessments (EIAs) written into both the *Environmental Impact Assessment Law* enacted in 2003 and *Government Information Regulations* enacted in 2007 [36]. The public review period of an EIA is too short

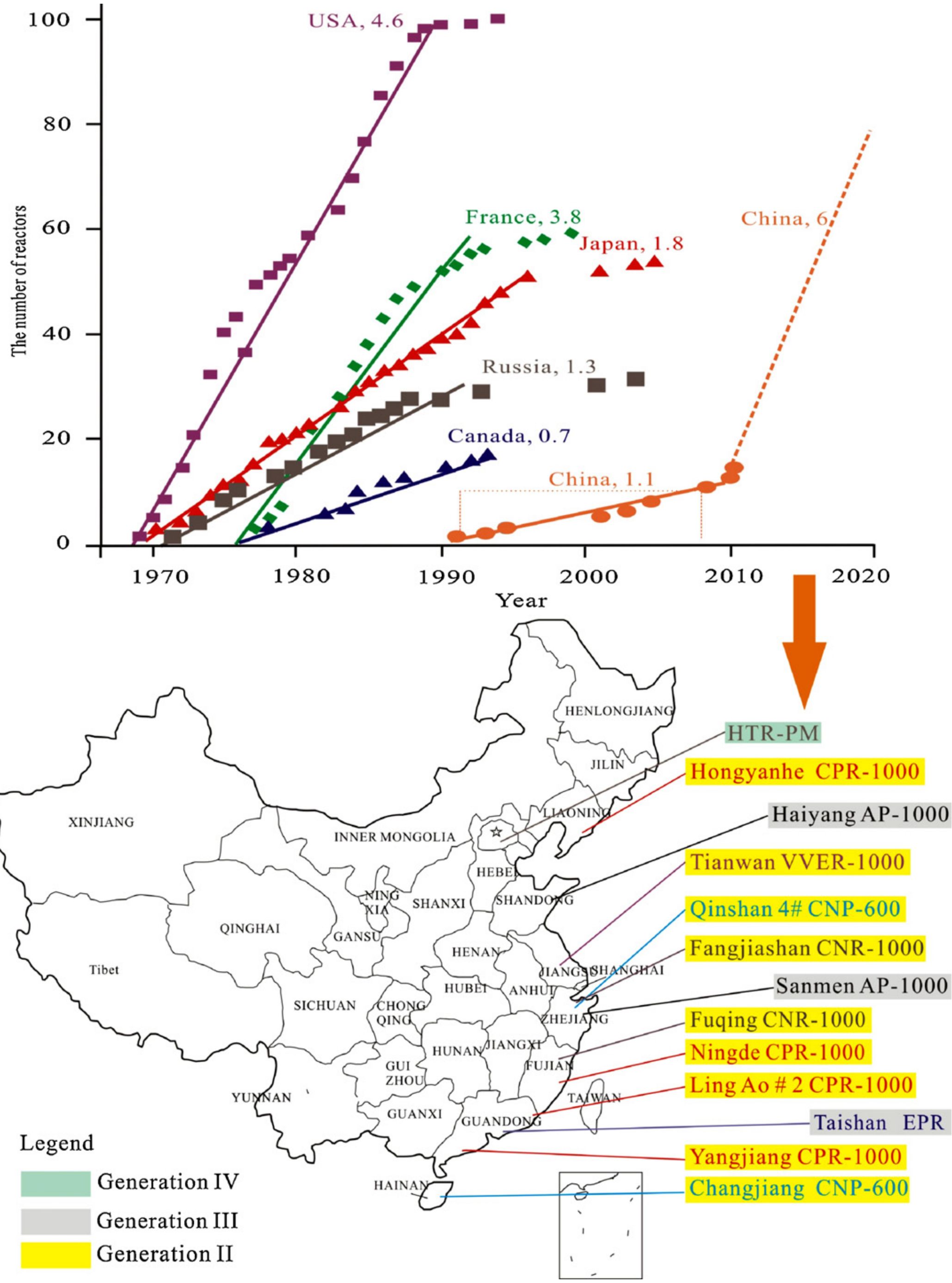


Fig. 1. China's unique approach to atomic energy – building too many types of reactor too fast.

Source [3,4,41–43].

(about 10 days) [39], making thorough evaluations nearly impossible [40]. Government agencies have yet to regularly inform the public of developments related to nuclear regulation, safety, and technology (e.g. hosting regular public meetings) [36].

This lack of public awareness and participation simplified building and operating procedures for reactors, facilitating in building too many types of reactors too fast – a unique approach to atomic energy (see Fig. 1).

Before the Fukushima nuclear accident, China had planned to increase its installed nuclear capacity to 86 GW, almost tenfold by 2020 (see Box 1). In 2010, China completed two new reactors (out of five globally) and broke ground on ten new reactors (out of fifteen globally) [3]. Reactors are even proposed in Chongqing and Sichuan, the provinces in China's most susceptible to earthquakes [41,44]. Unfortunately, the absence of public scrutiny has already enabled corruption in this unparalleled reactor expansion. In 2010, Kang Rixin, the former chief of one of China's leading nuclear operators was sentenced to life in prison for accepting at least $1 USD million in bribes [34]. Evidence of such corruption dramatically increases the risk of a nuclear accident, especially in a country so heavily invested in nuclear energy.

From the perspective of reactor technology, China seems to be the nuclear industry's living laboratory for new reactor designs and actual construction [34]. Initially, Qinshan I, an indigenously

Box 1

The genesis of China's nuclear energy goes back to "the 728 project" in the 1970s. In 1991, China's first reactor at Qinshan went into commercial operation. China had completed 11 units (8.6 GW) till 2007, when it set a nation target of 40 GW of installed nuclear capacity by 2020 [45]. However, the total installed capacity is estimated to be 43 GW by 2015, and 86 GW by 2020 [44,45].

Meeting its huge energy demand has become China's long-term challenge, fueled by an economy addicted to energy use [46]. In 2010, China, making up only 9.3% of the world's GDP [47], consumed 20.3% of the world's energy [48] and 28% of global industrial energy [49]. Although China's energy use more than doubled in the past decade, overtaking the US, its energy demand is expected to jump 75% between 2008 and 2035 [49]. Even as energy demand grows, China must discourage use of coal which provided approximately 70% of its primary energy [50]. China's current coal consumption is on par with the rest of world combined [48]. China has set a target to increase the proportion of non-fossil energy of total primary energy consumption from 8% in 2006 to 15% in 2020 [51].

China has also faced increasing pressure to reduce carbon emissions. In the 12th Five Year Plan (FYP), covering 2011–2015, China aims to cut carbon intensity (carbon emission/GDP) by 17%. This is the first time China set a national carbon reduction goal. This target will be followed by further carbon emission reductions in the 13th FYP (2016–2020) to meet a 40-45% carbon intensity reduction by 2020 relative to the 2005 level [52].

Nuclear power is an attractive solution. Nuclear energy provides 1.8% of China's electricity, whereas it generated about 14% of electricity globally, 19.6% of US electricity, and 74.1% of France's electricity in 2010 [42].

designed PWR reactor (CNP-300), and Daya Bay, with French PWR reactors (M-310) were developed synchronously [36,53]. In the haste to build reactors, 27 new reactors currently being built in China vary from generation II (CPR-600, CPR-1000, CNP-1000 and AES-91), to generation III (AP-1000 and EPR), to generation IV (HTR-PM) reactors [3,4,41,53]. As of February 2012, the AP-1000 reactors built in Sanmen, Zhejiang, and in Haiyang, Shandong are the only commercial units in the world to have begun construction. Among four EPR units under construction in the world, two units are being built in Taishan, Guangdong [44]. The eminent challenge facing China's nuclear operation is how to prevent the nuclear incident that happened in 1998, when its indigenous CNP-300 reactor at Qinshan was shut down for over 12 months to be rebuilt due to faulty design and defects in the welding of the steel vessel that contained the reactor [36,44].

4. A step toward nuclear regulatory transparency

To prevent the nuclear safety regulatory failures as occurred in Japan, public participation is readily encouraged by giving high priority to transparency in China. We proposed actions in two areas.

(i) Regulatory transparency

Transparency policies are effective only when the information they produce becomes embedded in the everyday decision-making routines of information users and information disclosers [54]. This double-sided embeddedness is the most important condition for transparency systems' effectiveness [55]. Thus various kinds of comprehensive civil atomic energy information should be available to the public, including general information on how China manages its atomic energy, and specific information, such as new reactor proposals. Meanwhile, this also warrants new nuclear regulatory laws to be enforced immediately, stipulating how China's nuclear watchdogs should conduct their regulatory responsibilities in an open and transparent manner.

(ii) Internet facilitating public involvement in nuclear issues

The internet, especially social networking, should be emphasized to facilitate the achievement of transparency, and engage citizens, especially youth, in nuclear issues. The Internet provides a means by which individual from all walks of life can launch public debates concerning nuclear issues and arouse the attention of the general public. Such popular swells of opinion have undoubtedly contributed to increasing public involvement [56]. The Internet has revolutionized popular expression, and contributed to making the regulatory system more transparent and accountable in China [57,58]. Some examples include the Xiamen anti-paraxylene event in 2007, the Guangzhou anti-trash incinerator event in 2009 [59] and the Dalian anti-paraxylene event in 2011 [60]. Trending toward more open social and political conditions, the Internet is bound to play a substantial role in facilitating public scrutiny over nuclear issues.

The Fukushima accident has served to remind us that transparency and public participation is an absolute condition for any country that uses atomic energy. Although highly advanced new reactors may reduce risks based on "inherent" safety technologies, such as "passively safe" measures developed by the generation III reactor [61,62], we believe that any country that does not provide proper transparency and encourage public involvement regarding nuclear issues must never use nuclear energy. China's leading nuclear energy growth gives an unprecedented opportunity for the country to become a leader of those emerging countries in transparency and public involvement in nuclear issues.

Acknowledgments

The authors would like to thank the four anonymous reviewers for their thoughtful, insightful and constructive comments. The authors also thank the Lawrence L. Kazmerski, Ph.D. Editor-in-Chief for his timely editing this manuscirpt. The current work is supported by the NSFC (41001384).

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